SIEBEIN
ACOUSTIC
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June 30, 2020

Mr. Hunter W. Chambliss
The Chambliss Group
221 Commercial Blvd., Suite 202
Lauderdale By the Sea, FL 33308

Dear Hunter:

This letter summarizes the site noise study for the proposed Kiwi Carwash PSL site in Port St. Lucie, Florida. The purpose of the study was to determine if the projected sound pressure levels at distances away from the proposed car wash equipment and car wash operations are in compliance with the sound level limit requirements of the Port St. Lucie Noise Ordinance. The study was conducted with Cadna-A software which is a state-of-the-art noise propagation modeling software. Acoustical measurements were taken of car wash equipment which consisted of a vacuum producer and vacuuming activities at a similar facility in Clermont, Florida on June 23, 2020, and on June 26, 2020, near the carwash entry and exit sides of a similar facility in Lauderhill, Florida.

SOUND LEVELS AND DECIBELS

Sound is defined as a pressure disturbance in the air caused by a vibrating body that is capable of being heard or detected by the human ear. The average sound pressure level or equivalent continuous sound level (LAeq) of a time-varying sound is defined as the level of an equivalent steady sound at a specific location for the same measurement duration that has the same A-weighted sound energy as the time-varying sound.

Sounds are typically measured in decibels. A decibel is 10 times the logarithm to the base 10 of the pressure disturbance in the air compared to the pressure at the threshold of human hearing. Decibels cannot be added directly because they are logarithmic ratios. For example, 2 sounds of 50 decibels each added together result in a sound of 53 dB, not 100 dB. A summary of the way that sounds of different levels are added together is shown in Table 1.

Table 1. Examples of the addition of different sound levels (dBA).

Sound level 1	Sound level 2	Combined sound level	Explanation
50 dBA	50 dBA	53 dBA	When two sounds of equal level are combined, the result is a 3 dB increase in sound level
50 dBA	52 dBA	54 dBA	When one sound is combined with another sound that is 2-3 dB louder than first sound, the combined sound level is 2 dB louder than the louder sound
50 dBA	55 dBA	56 dBA	When one sound is combined with another sound that is 4-7 dB louder than the first sound, the combined sound level is 1 dB louder than the louder sound
50 dBA	60 dBA	60 dBA	When one sound is 10 dB louder than another, the combined sound level is approximately equal to the louder sound level

The differences in sound levels are not perceived by people linearly either. One sound must be 10 dB louder than another sound for it to be heard as approximately twice as loud as the first sound. A sound that is 0 to 1 dB louder than another sound is heard as approximately the same loudness as the first sound. A sound that is 2 to 3 dB louder than another sound is heard as barely louder than the first sound. A sound that is 5 to 6 dB louder than another sound is heard as noticeably louder, but not twice as loud as the first sound. A summary of the perception of the relative loudness of two sounds is shown in Table 2.

The sound levels are measured in A-weighted decibels or dBA. An A-weighted decibel is one that has been adjusted so it corresponds to the relative loudness of middle level sounds as they are heard by human listeners. The low frequency or bass sounds are reduced by the A-weighting process and the higher pitch sounds that human ears are more sensitive to are increased slightly by the A-weighting process.

Table 2. Perception of the relative loudness of 2 sounds.

Difference in sound level between two sounds	The louder sound is perceived as (*) the quieter sound
0 to 1 dB	Not noticeably louder than*
2 to 3 dB	Barely noticeably louder than*
5 to 6 dB	Noticeably louder than, but not twice as loud as*
10 to 12 dB	Approximately twice as loud as*
15 dB	Approximately three times as loud as*
20 dB	Approximately four times as loud as*

In general terms, sound levels of 30 to 40 dBA are usually perceived by people as being relatively quiet. Normal conversation measured at approximately 3 feet from the person speaking is 60 to 65 dBA. Cars passing on a street or a residential air-conditioning unit are approximately 65 to 75 dBA. Loud night clubs and amplified music at concerts are often played at levels of 100 to 110 dBA.

METHOD

The method for the Site Noise Study consisted of the items listed below.

I. Take short term sound level measurements of car wash equipment and activities such as the vacuum producer and vacuuming activities at Joe's Express Car Wash in Clermont, Florida, and Prestige Car Wash in Lauderhill, Florida, to use as sound source data in the computer model of the facility.

II. Construct a 3-dimensional computer model of the site and the proposed equipment and car wash operations to determine sound levels at critical locations based on sound level data for the equipment to be installed in the proposed car wash facility.

III. Propose noise mitigation systems to reduce noise levels where necessary.

CRITERIA

Chapter 94 of the Port St Lucie Noise Ordinance "Noise" states that "no person shall operate or cause to be operated any source of sound from any location in such a manner as to create a sound level which exceeds the limits set forth in Table 1 for property in the receiving land use category when measured at or beyond the approximate real property line of the receiving property."

According to Section 94.04, the maximum permissible sound level limits when measured at a receiving property line from the source of the sound is 60 dBA/65 dBC daytime for residential properties receiving the sound and 65 dBA/70 dBC daytime for commercial properties receiving the sound.

Daytime as defined in the Noise Ordinance “means 7:00 a.m. to 11:00 p.m. the same day.” The hours of operation for the proposed car wash facility are proposed to be from 7:00 a.m. to 7:00 p.m according to Kiwi Carwash staff.

INSTRUMENTATION

A Larson Davis Model 831 Sound Level Meter was used as the basic instrumentation for the acoustical measurements. The meter meets ANSI Standard S1.4 requirements for Type 1 sound level meters. The Larson Davis was equipped with a PCB ½" diameter measurement microphone and preamplifier. The meter and microphone were calibrated with a Larson Davis CAL 200 calibrator prior to testing and tested to within + 0.1 dB of calibration after the measurements were complete. The meter and microphone were mounted on a tripod at approximately 5.5’ above grade at each measurement location. A windscreen was attached to the microphone for all measurements. The data were stored on the internal memory system of the meters, and downloaded into the computers in our office for analysis.

METHOD

A three-dimensional computer model was constructed using AutoCAD software which included the proposed car wash facility and the surrounding land area with buildings that extends approximately 800 to 1000 ft. from the approximate center of the proposed site for the car wash facility. The AutoCAD model was imported into Cadna-A software which is a state-of-the-art noise propagation modeling software.

The octave band sound pressure level data for one 50 HP Vac-U-Tech vacuum producer and vacuuming area was measured at a similar carwash site located in Clermont, Florida. The sound pressure level data for five Sonny’s 15 HP dryers including silencers was measured at a similar facility in Lauderhill, Florida. The measured sound level data were used as the sound source data in the model for the dryers near the exit side of the car wash, vacuum producers within walled enclosures, and vacuuming activities in the vacuuming area as shown on the proposed drawings of the Kiwi Car Wash facility in Port St. Lucie, Florida. The computer sound propagation model was used to calculate the sound levels from the proposed carwash activities to property lines on all sides of the site. Please refer to Table 1 below for the octave band values of the operating equipment used as sound sources in the analysis.

Table 1. Sound source data included in the acoustical model

Equipment	dBA	Type	Octave Band Values							
			63	125	250	500	1000	2000	4000	8000
Sonny’s Dryer	94 dBA	SPL @ 3ft (exit opening)	83	87	93	89	89	88	79	70
	73 dBA	SPL @ 50ft (entry opening)	75	75	75	71	68	65	60	54
Carwash Entry Equipment (dryer off)	75 dBA	SPL @ 3ft (entry opening)	68	66	69	69	68	68	68	66
Vacuum Producers	84 dBA	SPL @ 6ft	81	84	83	8.1	78	76	74	67
Vacuum Stations	67 dBA	SPL @ 10ft	73	69	62	59	59	61	61	61

Figures 1 and 2 shows resulting sound levels at nearby commercial properties calculated by the computer model software with the major sources of sound from the operating car wash facility such as the main car wash equipment with the dryer, vacuum producer and all vacuuming stations operating and ready for use by individuals.

The sound sources used in the computer model included the following.

1. Car wash operating with the Sonny's dryer equipment with silencers that consist of acoustically lined cylindrical covers attached to the air intake-side of the blowers.
2. Two vacuum producers operating within two enclosures consisting of four-sided 8 ft. tall walls.
    a. A single vacuum producer was located near the Entry side of the carwash.
    b. A second single vacuum producer was located near the vacuuming stations near the east of the property.
3. A total of 23 vacuuming stations ready for operation by patrons.

The computer model also included the following.

1. A roof over the vacuuming area.
2. The use of car wash dryer equipment with silencers located within the car wash building.
3. A 20 ft. deep landscape buffer between the exit side of the carwash and Gatlin Boulevard.
4. The proposed ABC Liquors building to be built across Gatlin Boulevard, directly north of the proposed Kiwi Carwash site.

RESULTS

1. The computer model demonstrates that the proposed car wash facility complies with the sound level limits in the Port St. Lucie Noise Ordinance at all surrounding residential and commercial properties.

2. Figure A1, in Appendix A, shows an aerial image of the site and the surrounding neighborhood with the projected sound levels that meet the residential daytime sound level limit of 60 dBA and the commercial daytime sound level limit of 65 dBA.

3. Figure A2, in Appendix A, shows an aerial image of the site and the surrounding neighborhood with the projected sound levels that meet the residential daytime sound level limit of 65 dBC and the commercial daytime sound level limit of 70 dBC.

4. The results of the computer model sound levels at the nearest receiving properties are summarized in table 2 below.

Table 2. Summary of resulting sound noise levels at nearest residential and commercial property lines

Orientation	Distance to nearest receiving property line form proposed Kiwi Carwash PSL	Nearest Receiving Property	Estimated Overall Sound Levels	
			dBA	dBC
North	213 ft.	**Commercial** (ABC Liquors)	52.4-64.9	56.9-67.3
Northeast	230 ft.	**Commercial** (RaceTrac Gas Station)	46.8-59.2	56.5-62.1
East	0 ft.	**Commercial** (AutoZone)	55.4-59.9	64.4-69.4
Southeast	62 ft.	**Commercial** (Yellowstone Landscaping)	53.3-57.3	62.9-65.6
South	0 ft.	**Undeveloped Property**	53.7-56.8	62.0-64.1
	810 ft.	**Nearest Residential Property**	<40.0	<50.0

Orientation	Distance to nearest receiving property line form proposed Kiwi Carwash PSL	Nearest Receiving Property	Estimated Overall Sound Levels	
			dBA	dBC
West	62 ft.	**Commercial** (ExtraSpace Storage)	53.3-60.7	61.6-67.8
Northwest	548 ft.	**Nearest Residential Property**	53.7-55.9	57.3-59.2

COMPUTER MODELSTUDY OF TRAFFIC NOISE FROM GATLIN BOLEVARD

1. An additional computer model was conducted to estimate noise levels from vehicles traveling on Gatlin Boulevard at the receiving property site to the north of the proposed Kiwi Carwash PSL.

   a. The HUD Online Environmental Planning Division Day/Night Noise Level Calculator, which is an electronic assessment tool used to calculate the resulting DNL for the proposed site, was used as to determine the estimated DNL of the site.

   b. According to FDOT, average annual daily traffic (AADT) counts for Gatlin Boulevard were 50,500 in the year 2019. Vehicle counts for large truck were 2,424 in the year 2019. The sound levels from traffic are estimated to be 73 dBA. This means that average daily noise propagated from vehicles traveling on Gatlin Boulevard is estimated to be higher than the estimated sound pressure level from noise due to the operation of the carwash equipment.

   c. The results from the HUD Environmental Planning Division Day/Night Noise Level Calculator showed that traffic noise levels at many commercial properties along the north and south sides of Gatlin Boulevard such as the proposed ABC Liquors site across the Gatlin Boulevard, the ExtraSpace Storage site to the west of the Kiwi Car Wash, and the AutoZone site to the east of the Kiwi Carwash site will be 73 dBA which is greater than the estimated sound level from the carwash facility at the receiving property line.

   d. This input sheets and calculations for the online HUD Environmental Planning Division Day/Night Noise Level Calculator are included in Appendix C.

CONCLUSION

1. The computer model demonstrates that the sounds propagating from the operation of the proposed car wash facility comply with the sound level limits of the Port St. Lucie Noise Ordinance at all surrounding residential and commercial properties.

2. The traffic noise model study also indicates that the Day-Night average noise level from vehicles traveling on Gatlin Boulevard would be higher than those propagating from the proposed car wash facility to the commercial properties to the north, east and west of the site.

3. Sound levels presented in Figure A1 and A2, in Appendix A, show that the residential daytime sound level limit of 60 dBA/65 dBC and the commercial daytime sound level limit of 65

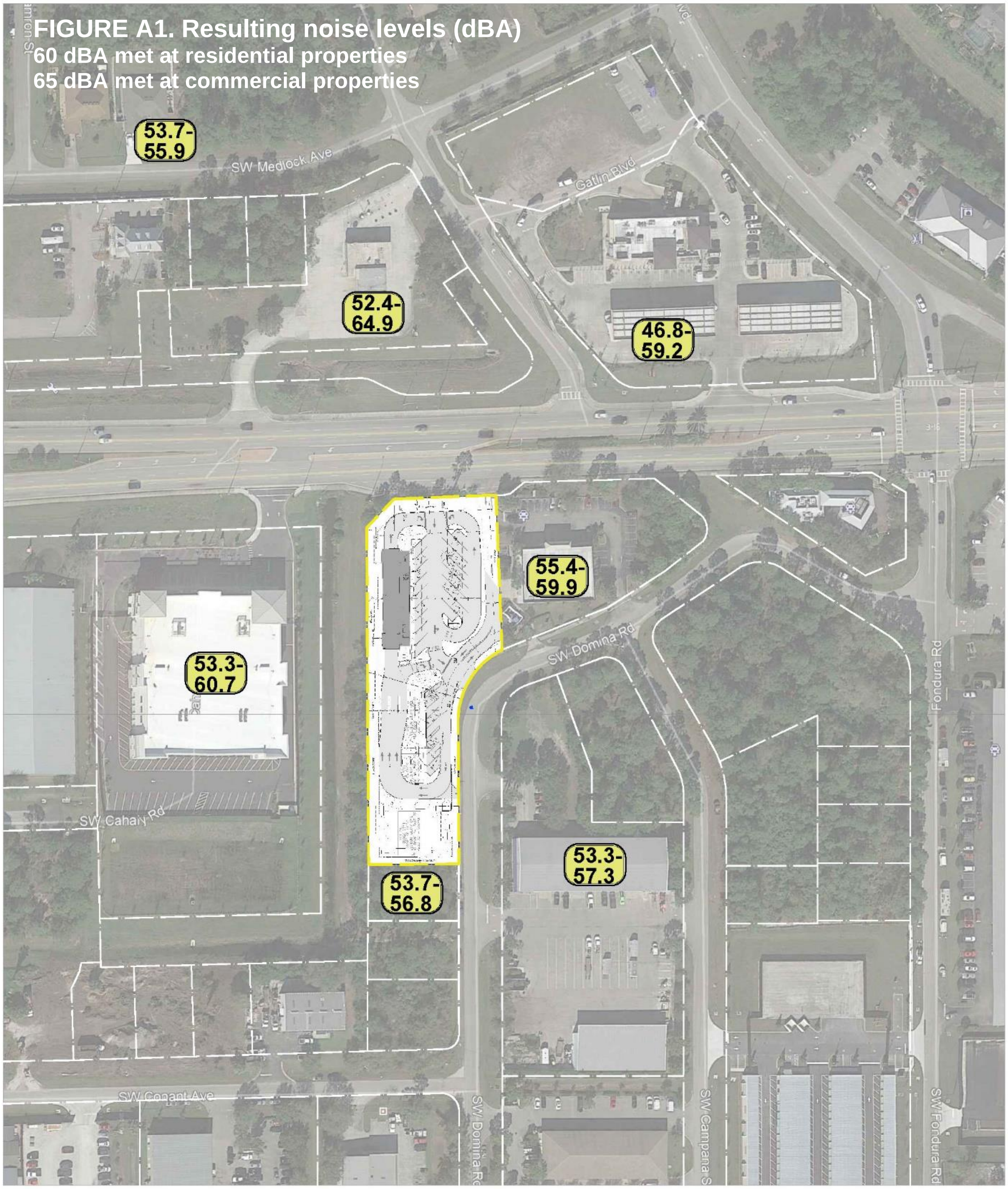
dBA/70 dBC are met at all locations around the car wash with the car wash equipment operating.

Please do not hesitate to contact us if you have any questions or if we can be of additional assistance in this regard.

Sincerely,
SIEBEIN ASSOCIATES, INC.

Marylin Roa AIA, ASA, INCE
Senior Consultant

APPENDIX A
RESULTING SOUND LEVELS PROPAGATED FROM KIWI CARWASH



NOISE CONTOUR MAP KEY:

# - #	Computer model estimated sound levels at receiving property lines facing the proposed project location

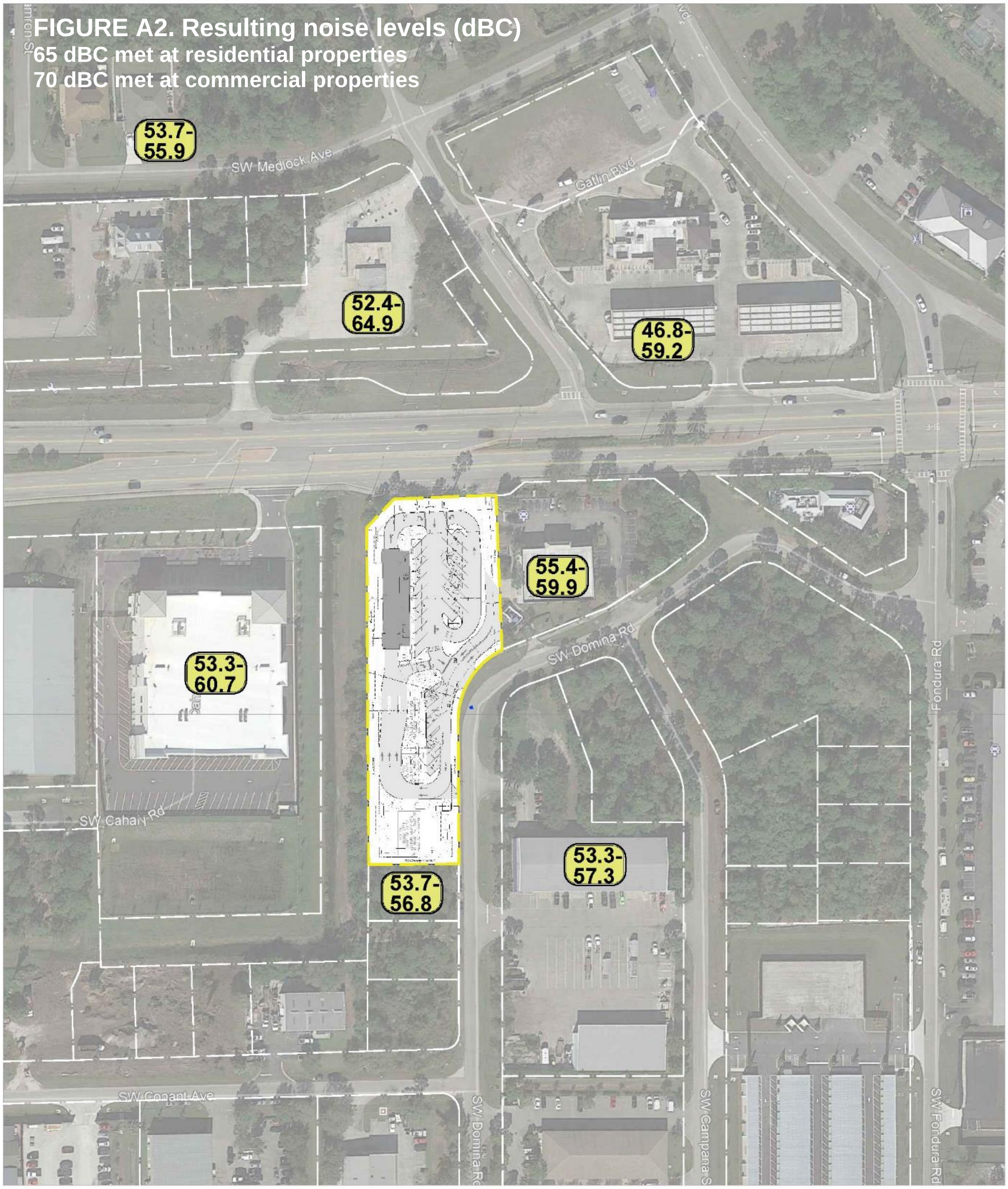


FIGURE A2. Resulting noise levels (dBC)
65 dBC met at residential properties
70 dBC met at commercial properties

NOISE CONTOUR MAP KEY:

 # - # Computer model estimated sound levels at receiving property lines facing the proposed project location

APPENDIX B

SUMMARY OF MEASUREMENT TRIPS TAKEN TO EXISTING CAR WASH FACILITIES WITH SIMILAR EQUIPMENT TO THE PROPOSED KIWI CAR WASH TO USE AS SOUND DATA USED IN THE COMPUTER MODEL STUDY

SUMMARY OF MEASUREMENT TRIPS TAKEN TO EXISTING CAR WASH FACILITIES WITH SIMILAR EQUIPMENT TO THE PROPOSED KIWI CAR WASH TO USE AS SOUND DATA USED IN THE COMPUTER MODEL STUDY

Two trips were made to existing car wash facilities to taken short term sound level measurements of car wash equipment and activities similar to those at the Kiwi Carwash facility which manufacturers' data were not available. Acoustical measurements of a 50 HP vacuum producer as well as vacuuming activities were taken on July 23, 2020, at Joe's Express Car Wash in Clermont, Florida. Acoustical measurements for five Sonny's 15 HP dryers including silencers were measured at Prestige Carwash in Lauderhill, Florida.

A Larson Davis Model 831 Sound Level Meter was used as the basic instrumentation for the acoustical measurements. The meter meets ANSI Standard S1.4 requirements for Type 1 sound level meters. The Larson Davis was equipped with a PCB ½" diameter measurement microphone and preamplifier. The meter and microphone were calibrated with a Larson Davis CAL 200 calibrator prior to testing and tested to within + 0.1 dB of calibration after the measurements were complete. The meter and microphone were mounted on a tripod at approximately 5.5' above grade at each measurement location. A windscreen was attached to the microphone for all measurements. The data were stored on the internal memory system of the meters, and downloaded into the computers in our office for analysis.

The acoustical measurements for the 50 HP vacuum producer as well as vacuuming activities taken Joe's Express Carwash were used as the sound source data in the computer model for the proposed vacuum producer and vacuuming areas proposed at Kiwi Carwash facility. Receiver C1 was located approximately 10ft. from the vacuum stations which were operating during the time of the acoustical measurements. Receiver C2 was located approximately 6 ft. from a 50 HP vacuum producer that was not enclosed within a wall enclosure. Figure B1 shows an aerial map with the approximately location of Receiver C1 and Receiver C2 at Joe's Express Carwash in Clermont, Florida. A summary of the sound source data included in the computer model for the vacuum producer and vacuuming activities is listed in Table B1.

Table B1. Octave band sound pressure level data included in the computer model based on acoustical measurements taken for the 50 HP vacuum producer as well as vacuuming activities taken at Joe's Express Carwash.

Reference	Equipment	One-third Octave Band Frequency Sound Pressure Level in dB								
Figure B2 Receiver C1	**VACUUM STATION** (10 ft. from vacuum post)	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**
		64	61	62	66	69	68	63	66	62
		200	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
		59	56	54	53	55	54	54	54	53
		1600	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
		55	57	56	55	57	56	57	56	55
Figure B2 Receiver C2	**VACUUM PRODUCER** (6ft. from pump)	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**
		68	70	74	77	78	73	72	80	81
		200	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
		79	78	77	78	80	77	75	72	71
		1600	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
		71	72	71	69	70	67	64	61	59

Figure B1. Aerial image showing measurement locations at Joe's Express Carwash in Clermont, Florida, for the source data included in the computer model.

Figure B2. Photographs of the vacuum producer and vacuum stations at Joe's Express Carwash in Clermont, Florida.

The acoustical measurements of the sound propagating from the entry and exit sides of the car wash building at Prestige Carwash in Lauderhill, Florida, were used as the sound source data in the computer model for the Kiwi Carwash facility. Sound level measurements at Receiver L1, located approximately 3 ft. from the exit opening of the carwash, were taken during the operation of 5 Sonny's driers as a vehicle approached the final stage of the carwash. Receiver L2 was located approximately 50 ft. from the entry side of the carwash. Sonny's Dryers were operating during the time acoustical measurements at Receivers L1 and L2 were taken. An additional measurement was taken approximately 3ft. from the entry side of the carwash during which a vehicle had just entered the first stage in the carwash and the air dryers were not operating. Figure B3 shows an aerial map with the approximate location of Receiver L1, L2, and L3 taken at Prestige Carwash in Lauderhill, Florida. A summary of the sound source data included in the computer model is listed in Table B2.

Table B2. Octave band sound pressure level data included in the computer model based on acoustical measurements taken for five Sonny's driers operating at Prestige Carwash.

Reference	Equipment	One-third Octave Band Frequency Sound Pressure Level in dB								
Figure B4 Receiver L1	**SONNY'S DRYER** (3 ft. from exit opening)	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**
		72	75	78	78	80	77	78	79	86
		200	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
		87	90	88	82	85	84	84	83	85
		1600	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
		85	83	81	77	74	71	68	65	62
Figure B4 Receiver L2	**SONNY'S DRYER** (50 ft. from entry opening)	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**
		66	64	69	69	72	68	67	70	71
		200	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
		71	70	70	66	65	67	65	62	62
		1600	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
		62	60	59	57	55	53	52	49	45
Figure B4 Receiver L3	**CARWASH ENTRY EQUIPMENT** (3 ft. from opening) (drier off)	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**	**100**	**125**	**160**
		77	68	61	61	66	59	61	62	62
		200	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
		64	64	64	64	64	64	64	63	63
		1600	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
		63	63	63	63	63	63	62	62	61

Figure B3. Aerial image showing measurement locations at Prestige Carwash in Lauderhill, Florida, for the source data included in the computer model.

Figure B4. Photographs of acoustical measurements and Sonny's driers near the exit side taken at Prestige Carwash in Lauderhill, Florida.

APPENDIX C
COPY OF INPUTS AND CALCULATION RESULTS FROM THE HUD ONLINE ENVIRONMENTAL PLANNING DIVISION DAY/NIGHT NOISE LEVEL CALCULATOR

Home (/) > **Programs (/programs/)** > **Environmental Review (/programs/environmental-review/)** > DNL Calculator

DNL Calculator

The Day/Night Noise Level Calculator is an electronic assessment tool that calculates the Day/Night Noise Level (DNL) from roadway and railway traffic. For more information on using the DNL calculator, view the **Day/Night Noise Level Calculator Electronic Assessment Tool Overview (/programs/environmental-review/daynight-noise-level-electronic-assessment-tool/)**.

Guidelines

- To display the Road and/or Rail DNL calculator(s), click on the "Add Road Source" and/or "Add Rail Source" button(s) below.
- All Road and Rail input values must be positive non-decimal numbers.
- All Road and/or Rail DNL value(s) must be calculated separately before calculating the Site DNL.
- All checkboxes that apply must be checked for vehicles and trains in the tables' headers.
- **Note #1:** Tooltips, containing field specific information, have been added in this tool and may be accessed by hovering over all the respective data fields (site identification, roadway and railway assessment, DNL calculation results, roadway and railway input variables) with the mouse.
- **Note #2:** DNL Calculator assumes roadway data is always entered.

DNL Calculator

Site ID	GATLIN BLVD
Record Date	06/26/2020
User's Name	SA MR

Road # 1 Name:	**GATLIN BLVD**

Road #1

Vehicle Type	Cars ☑	Medium Trucks ☐	Heavy Trucks ☑
Effective Distance	116		116
Distance to Stop Sign			
Average Speed	45		45
Average Daily Trips (ADT)	50500		2424
Night Fraction of ADT	15		15
Road Gradient (%)			1
Vehicle DNL	68	0	72
Calculate Road #1 DNL	73	Reset	

Add Road Source Add Rail Source

Airport Noise Level	
Loud Impulse Sounds?	○Yes ○No

Combined DNL for all Road and Rail sources	**73**
Combined DNL including Airport	**N/A**
Site DNL with Loud Impulse Sound	

Calculate Reset

Mitigation Options

If your site DNL is in Excess of 65 decibels, your options are:

- **No Action Alternative**: Cancel the project at this location
- **Other Reasonable Alternatives**: Choose an alternate site
- **Mitigation**
  - **Contact your Field or Regional Environmental Officer (/programs/environmental-review/hud-environmental-staff-contacts/)**
  - Increase mitigation in the building walls (only effective if no outdoor, noise sensitive areas)
  - Reconfigure the site plan to increase the distance between the noise source and noise-sensitive uses
  - Incorporate natural or man-made barriers. See ***The Noise Guidebook (/resource/313/hud-noise-guidebook/)***
  - Construct noise barrier. See the **Barrier Performance Module (/programs/environmental-review/bpm-calculator/)**

Tools and Guidance

Day/Night Noise Level Assessment Tool User Guide (/resource/3822/day-night-noise-level-assessment-tool-user-guide/)

Day/Night Noise Level Assessment Tool Flowcharts (/resource/3823/day-night-noise-level-assessment-tool-flowcharts/)